

CLAIMS

What is claimed is:

- 1 1. An eye-safe laser comprising:
2 a laser for coupling to a source of pump energy to
3 generate laser energy; and
4 a wavelength shifting crystal coupled to the laser
5 for generating eye-safe light from the laser energy.
- 1 2. The eye-safe laser of Claim 1 wherein the
2 laser energy has a wavelength of about 1.3 microns.
- 1 3. The eye-safe laser of Claim 1 wherein the
2 eye-safe light has a wavelength of about 1.5 microns.
- 1 4. The eye-safe laser of Claim 1 further
2 comprising the source of pump energy.
- 1 5. The eye-safe laser of Claim 4 wherein the
2 source of pump energy comprises a laser diode or a laser
3 diode array.
- 1 6. The eye-safe laser of Claim 1 wherein the
2 wavelength shifting crystal comprises a Raman shifting
3 crystal.
- 4 7. The eye-safe laser of Claim 6 wherein the
5 Raman shifting crystal comprises BaNO_3 or $\text{KGd}(\text{WO}_4)_2$.
- 1 8. The eye-safe laser of Claim 1 further
2 comprising a reflective coating on an inside end face of
3 the wavelength shifting crystal that is highly
4 transmissive of the laser energy and is highly reflective
5 of the eye-safe light.

1 9. The eye-safe laser of Claim 1 further
2 comprising a reflective coating on an outside end face of
3 the wavelength shifting crystal that is highly reflective
4 of the laser energy and is highly transmissive of the
5 eye-safe light.

1 10. The eye-safe laser of Claim 1 wherein the
2 laser comprises:
3 an input coupler for coupling to a source of pump
4 energy;
5 a laser gain element coupled to the input coupler
6 for generating laser energy from the pump energy; and
7 an output coupler coupled to the laser gain element.

1 11. The eye-safe laser of Claim 10 wherein the
2 input coupler, the laser gain element, the output
3 coupler, and the wavelength shifting crystal are joined
4 by at least one of diffusion bonding, gluing, and optical
5 contacting by mechanical means.

1 12. The eye-safe laser of Claim 10 further
2 comprising a passive Q-switch coupled to the laser gain
3 element for increasing peak power output.

1 13. The eye-safe laser of Claim 12 wherein the
2 input coupler, the laser gain element, the passive Q-
3 switch, the output coupler, and the Wavelength shifting
4 crystal are joined by at least one of diffusion bonding,
5 gluing, and optical contacting by mechanical means.

1 14. The eye-safe laser of Claim 12 wherein the
2 passive Q-switch comprises a passive Q-switch material.

1 15. The eye-safe laser of Claim 13 wherein the
2 passive Q-switch material is V^{3+} :YAG or Nd^{2+} : SrF_2 .

1 16. The eye-safe laser of Claim 12 wherein the
2 output coupler comprises a reflective coating between the
3 Q-switch and the wavelength shifting crystal that is
4 partially reflective of the laser energy and is highly
5 reflective of the pump energy.

1 17. The eye-safe laser of Claim 10 further
2 comprising a focusing lens coupled to the laser diode for
3 focusing pump energy on the laser gain element.

1 18. The eye-safe laser of Claim 10 wherein the
2 input coupler comprises a reflective coating on an end
3 face of the laser gain element between the laser gain
4 element and the pump energy source that is highly
5 transmissive of the pump energy and highly reflective of
6 the laser energy.

1 19. The eye-safe laser of Claim 10 wherein the
2 output coupler comprises a reflective coating between the
3 laser gain element and the Wavelength shifting crystal
4 that is partially reflective of the laser energy and
5 highly reflective of the pump energy.

1 20. The eye-safe laser of Claim 10 wherein the
2 laser gain element comprises an $\text{Nd}^{3+}:\text{YAlO}_3$ crystal having
3 a laser wavelength of about 1.3 microns.

1 21. An eye-safe laser comprising:
2 means for generating laser energy; and
3 means for transforming the laser energy into eye-
4 safe light.

1 22. The eye-safe laser of Claim 21 wherein the
2 laser energy has a wavelength of about 1.3 microns.

1 23. The eye-safe laser of Claim 21 wherein the

2 eye-safe light has a wavelength of about 1.5 microns.

1 24. The eye-safe laser of Claim 21 wherein the
2 means for generating laser energy comprises:

3 an input coupler for receiving pump energy;
4 a laser gain element coupled to the input coupler
5 for generating laser energy from the pump energy; and
6 an output coupler coupled to the laser gain element.

1 25. The eye-safe laser of Claim 24 further
2 comprising means for generating the pump energy.

1 26. The eye-safe laser of Claim 25 wherein the
2 means for generating the pump energy comprises a laser
3 diode or a laser diode array.

1 27. The eye-safe laser of Claim 24 wherein the
2 input coupler, the laser gain element, the output
3 coupler, and the means for transforming the laser energy
4 into eye-safe light are joined by at least one of
5 diffusion bonding, gluing, and optical contacting by
6 mechanical means.

1 28. The eye-safe laser of Claim 24 further
2 comprising means for increasing peak power output of the
3 laser gain element.

1 29. The eye-safe laser of Claim 28 wherein the
2 means for increasing peak power output comprises a
3 passive Q-switch material.

1 30. The eye-safe laser of Claim 29 wherein the
2 passive Q-switch material is V^{3+} :YAG or Nd^{2+} : SrF_2 .

1 31. The eye-safe laser of Claim 24 further
2 comprising means for focusing the pump energy on the
3 laser gain element.

1 32. The eye-safe laser of Claim 24 wherein the
2 laser gain element comprises an $\text{Nd}^{3+}:\text{YAlO}_3$ crystal having
3 a laser wavelength of about 1.3 microns.

1 33. The eye-safe laser of Claim 21 wherein the
2 means for transforming comprises BaNO_3 or $\text{KGd}(\text{WO}_4)_2$.